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THE CHEMISTRY OF PLANTS.

Biochemie der Pflanzen. Vol. i. By Prof. Friedrich Czapek. Pp. xv+584. (Jena: Gustav Fischer, 1905.) Price 14 marks.

THIS work forms a new type among those on physiological botany: in some degree it resembles "Die Pflanzenstoffe" of Husemann and Hilger, and "Die rohen Stoffe des Pflanzenreiches" of Wiesner; but whereas the bias of the former is pharmacological, and that of the latter economic, the subject is treated in this volume more from the chemical standpoint.

The author states that his book is not to be regarded as a treatise or handbook for students, but as a work for reference, and that he has endeavoured to show in it what results the application of chemical methods to the problems of botanical physiology have yielded.

The subject-matter is divided into three parts—a historical introduction of 19 pages; a general part of 62 pages; and a special part of 489 pages. The general part is divided into two chapters, dealing respectively with the substratum of chemical processes in the living organism, and with the processes themselves. The first chapter treats of protoplasm and its constituents, colloids, then protoplasmic structures and their biochemical import; the second of reactions from the standpoint of general chemistry, a survey of the conditions of reactions, ionic reactions in the living cell, the velocities of reactions, catalysis, the general chemistry of enzymes, cytotoxins, and similar substances being here made.

The special part is concerned with the occurrence, metabolism, and metastasis of aliphatic substances in detail. The general arrangement of this part is in the first order chemical: the first section is devoted to fats, lecithins, phytosterins, and waxes; the second to carbohydrates, commencing with the simpler sugars, and ending with the substances forming the skeletal structure of plants. In the second order the arrangement is mixed; the chapters deal in part with the taxonomic, in part with the morphological, anatomical, and histological distribution of substances, and further with the physiology of the various bodies considered.

Photosynthesis receives considerable attention, and is regarded in all aspects; in connection with it the physics and chemistry of chlorophyll are discussed at length, and other pigments are also dealt with. The treatment of the physics and chemistry of starch is also fairly extensive. An index of the subjects and authors will be given at the end of the completed work.

The general nature and structure of the book having been reviewed, passage to criticism of it will now be convenient. A work of this kind, involving the two main ideas of chemistry and plants, requires, if it is to yield its full value, so to be arranged as to enable the composition or metabolism of a plant (in so far as this is known), as well as the distribution of a substance or a process, to be ascertained with equal

ease. But this is not the case with this work owing to its arrangement; the mode of treatment is analytic rather than synthetic. In "Die Pflanzenstoffe" one volume deals with the material from the chemical, the other from the taxonomic standpoint; but this method, although very convenient, necessitates duplication. The difficulty could have been here met through use of a suitable and strictly methodical arrangement, had the divisions of various orders of magnitude been formed from different standpoints, and had those which constituted each order been of similar kind and value. The end can be still attained here by aid of a copious and well-arranged index of the subject-matter.

Printers' errors are not very numerous, and occur chiefly in the earlier part of the book.

Discrepancies and slips of the pen are noticeable here and there. For example, on p. 7 Priestley is given as the discoverer of oxygen, but on p. 12 Scheele; on p. 144 *anaërobem* should be *aërobem*; *Bedeutung* on p. 434 should be *Beleuchtung*. From the structure of a sentence on p. 39 one might suppose that ethyl-ether was insoluble in water. Further, the last paragraph on p. 313 is hardly consonant with the author's apparent acceptance of Meyer's hypothesis of the structure of starch-granules on p. 312.

Since the work is one for reference, hence a compilation, and since the author has intentionally almost entirely avoided critical remarks on the subject-matter, the reviewer can only consider the selection from a critical standpoint. It may be said, on the whole, that the selection has resulted in a very representative collection of diverse opinions on controverted questions, and in many cases almost an exhaustive one. As a result of this, condensation is, in the case of many papers, extreme, and at times there is omission; but this is almost a necessary consequence of the mass of literature consulted.

One disadvantage, which is, however, common to all books of this class, is the slight indication of the relative values of the various works cited; all emerge with equal distinctness, except in so far as more space is given to some than to others; beyond this clue there is no guide to their relative worth. This is well shown in the case of the chemistry of starch and some of the pigments; a chemist or botanist who had not devoted any special attention to these substances would rise from a perusal of the epitome here given under the impression that there was only chaos.

In connection with the chemistry of starch the author does not seem to have had at hand all the works of H. T. Brown and his collaborators, G. H. Morris and J. H. Millar, or to have grasped their views quite clearly.

Enzymes are stated to be colloidal catalysors, and their colloidal state is said to be of import. In the opinion of the reviewer there is no sufficient evidence to show that any enzyme is a colloid, and, indeed, considerable reason why many should not be so. There is even no sufficient evidence that enzymes are chemical compounds; they may be essentially mixtures, or merely functions of special conditions.

In the consideration of the action of accelerators

and retarders on amylohydrolysis, there is no mention of Ford's recent work.

Cytase is stated not to occur in resting seeds, but it is present in small amounts in some.

In giving directions for the preparation of Schweizer's solvent for cellulose, the best method, that of dissolving metallic copper in ammonia through which a current of air is passed, is not mentioned.

The function of a critic is to criticise; but he is human, and hence prone to eulogise—or blame. In this case the reviewer can only yield praise. The work fills a void that botanical physiologists have long felt. The wealth of material dealt with is surprising, and the expenditure of labour must have been enormous. There is very little evidence of partiality, whether national or of other kind. The compass of the work is wide, and it is thoroughly up to date.

The reviewer was especially pleased with the general part. For the first time in a botanical work adequate stress is put on the importance of colloids as such, and on the necessity of knowledge of their nature for progress in physiology; and for the first time the principles of general chemistry are given the position due to them in a work of this class. To Prof. Czapek for having done this all botanical physiologists must remain indebted.

In the opinion of the reviewer the value of the work would have been enhanced by incorporation in it of curves illustrating the various processes described, and by citation of mathematical expressions wherever they have been proved or found to be applicable.

If the work should run through subsequent editions, as is most likely, it would certainly be best for different authors to be delegated for various parts, since with the rapid accumulation of material it will soon be impossible for a single author to deal adequately with a work of such dimensions.

F. ESCOMBE.

THE ELECTROMAGNETIC THEORY OF INERTIA.

- (1) *Mathematische Einführung in die Elektronentheorie.* By Dr. A. H. Bucherer. Pp. 148. (Leipzig and Berlin: Teubner, 1904.) Price 3.20 marks.
- (2) *Experimentelle Elektrizitätslehre.* By Dr. H. Starke. Pp. xiv + 422. (Leipzig and Berlin: Teubner, 1904.) Price 6 marks.
- (3) *Leitfaden der Physik für die oberen Klassen der Realanstalten.* By Dr. F. Bremer. Pp. viii + 294. (Leipzig and Berlin: Teubner, 1904.) Price 3.20 marks.

(1) **T**HE property of matter which has always been regarded as most fundamental is "inertia." This property is adopted as the measure of quantity of matter in dynamics, and the nearest approach to a complete explanation of a physical phenomenon is generally supposed to have been reached when the phenomenon has been shown to be due to the motion of particles possessing inertia. We may say, in fact, that the tendency of nineteenth century physics was

to give a purely dynamical explanation of everything. A striking example of this tendency is Maxwell's dynamical theory of the electromagnetic field.

In 1881 it was shown by Prof. J. J. Thomson that a particle charged with electricity possesses some inertia due to its electric charge in addition to the ordinary inertia of the particle. As the result of Kaufmann's measurements, we now know that all the inertia of an electron is of this electromagnetic kind. It is now further suggested that all matter is composed of electrons, so that all inertia is electromagnetic. Density, according to this view, is simply number of electrons per unit volume. Electromagnetic inertia, that is, all inertia, is due to the energy of the magnetic field produced by the moving charge of electricity. The energy of this magnetic field resides in the ether. According to Maxwell's dynamical theory, the electromagnetic energy of the ether is due to motion of parts of the ether, these parts possessing inertia. But the only kind of inertia which we really know is the inertia of matter, which is due to the electromagnetic action of the electrons of which matter is made up. If inertia is due to electrons, then if we ascribe to parts of the ether the property of inertia we ought to say that the ether contains so many electrons per unit volume. But the free ether is not supposed to contain any electrons; in fact, if we explain inertia by the energy of the magnetic fields produced by moving charges, then evidently to explain this energy by inertia in the ether is merely to argue in a circle. The position is, then, that inertia is explained in terms of the electromagnetic field, and that now some explanation of this field is required not involving inertia at all. So far, no such explanation has been offered. Larmor has suggested that the ether has an enormous density or inertia per unit volume, and that it moves along the lines of magnetic force. This explanation must evidently be abandoned if matter is regarded as made up of electrons having only electromagnetic energy, or else we must say that the ether has a sort of inertia, not the same as the inertia of matter, but like the kind of inertia matter was supposed to have before the electromagnetic theory of inertia was put forward.

To say this, however, is merely to ascribe to the ether a property the definition of which is that it explains what it is required to explain; it is, in fact, merely the old process of "explaining" a thing by inventing a name for its explanation. The properties of the ether, then, expressed by Maxwell's system of equations are at present without any explanation, but they have taken the place of inertia as the fundamental thing in terms of which phenomena are to be explained. In these circumstances the appearance of Dr. Bucherer's small volume on "Elektronentheorie" is exceedingly opportune. It contains a concise and readable account of Lorentz's splendid theory and of the electromagnetic theory of inertia. The introduction gives a short account of the properties of cathode rays and radium radiation, which, of course, are the properties of electrons on which the elektronentheorie is based. Chapters i. and ii. contain a short account of Lorentz's theory for bodies at rest, and chapters